S
1
.A28

SEP 8 1938

AGRICULTURAL NEWS LETTER

VOL. 6 - NOS. 8 AND 9 AUG.—SEPT., 1938

This publication gives information on new developments of interest to agriculture on laboratory and field investigations of the du Pont Company and its subsidiary companies.

In addition to reporting results of the investigations of the Company and its subsidiaries, published reports and direct contributions of investigators of agricultural experiment stations and other institutions are given dealing with the Company's products and other subjects of agricultural interest.

DU PONT
REG. U. S. PAT. OFF.

ISSUED BY PUBLIC RELATIONS DEPARTMENT, E. I. DU PONT DE NEMOURS & CO., INC., WILMINGTON, DEL.

THIS PUBLICATION WILL BE SENT TO YOUR ASSOCIATES WHO ARE ENGAGED IN TECHNICAL WORK IN AGRICULTURE

More or less frequently readers of the AGRICULTURAL NEWS LETTER request that the publication be sent to one or more of their associates. Ordinarily, we are glad to comply.

It is to explain, however, that a condition for placing names on the mailing list is that those who are to receive the Letter be technical workers in some line associated with agriculture.

The policy of limiting distribution is for the obvious reason that the contents of the Letter consist mostly of information which is of interest only to the technically trained.

We will be pleased to send the AGRICULTURAL NEWS LETTER regularly and without cost to any of your associates who are engaged in work of a technical character.

In making requests please state the branch of work of your associates. It is helpful to us to know how many readers are interested in particular subjects -- entomology, plant pathology, agronomy, agricultural chemistry, agricultural engineering, etc.

AGRICULTURAL NEWS LETTER
S. W. LONG, EDITOR

AGRICULTURAL NEWS LETTER

Vol. 6 - Nos. 8 and 9 August - September 1938.

This issue contains: Page

A Tire-Tube Method of Treating Nondurable Wood Posts Developed at United States Forest Products Laboratory 101

Sulfamic Acid 111

New Reasons and Modern Methods for Treating Seed Grains 113

The Wildlife Crop 117

Physiological Acidity of Commercial Mixed Fertilizers 120

#########

Agricultural News Letter (du Pont)
Vol. 6 - Nos. 8 and 9, August-September, 1938.

A TIRE-TUBE METHOD OF TREATING NONDURABLE WOOD POSTS DEVELOPED AT UNITED STATES FOREST PRODUCTS LABORATORY.

EDITOR'S NOTE:- The development of simple means by which farmers can treat fence posts with zinc chloride and thereby add years to the durability of the posts is a distinct contribution to economy in upkeep on farms. This method was developed by the United States Department of Agriculture, Forest Service, Forest Products Laboratory, Madison, Wisconsin, in cooperation with the University of Wisconsin.

By George M. Hunt, Principal Chemist,
and
R. M. Wirka, Engineer.

Fence posts of nondurable wood can be made to have 20 to 30 years life, or even more, by thorough pressure treatment with coal-tar creosote or mixtures of creosote with other suitable oils. Similar results can be obtained with these preservatives by the hot-and-cold bath method of treatment described in Farmers' Bulletin 744, "The Preservative Treatment of Farm Timbers." This can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 5¢ a copy (stamps not accepted). Hundreds of thousands of posts treated by these methods are now in successful service throughout the country. Many farmers and other post users have failed to take advantage of these treatments, however, and are continuing to use short-lived, untreated posts. While thorough impregnation with creosote is highly effective and economical, the cash outlay required for such treatment is considerable. No better treatment for posts is known but, if it is necessary to keep the cash outlay as low as possible, some other method will often have to be used.

One of the simplest and cheapest methods that can be used with assurance of good durability is the tire-tube method, illustrated in figure 1, which is an adaptation of the old Boucherie process. It consists in treating thoroughly green, round posts with the bark on by forcing preservative solution endwise through the sapwood portion of the post. The method is not recommended for split posts. In making the treatment, the bark is peeled for a distance of 4 to 6 inches from the large end of the post, to provide a smooth, clean surface. A section of inner tube about 2 or 2-1/2 feet long, cut from a used tire, is then slipped over the peeled surface and bound in place with cord, wire, rubber band, or any other convenient and suitable material. The post is then laid on a rack with the large end about 1-1/2 feet or more higher than the small end. The loose end of the tire section is then fastened to a frame so that the preservative cannot spill out but will be kept in close contact with

Continued on next page

the end of the post and a measured amount of preservative solution poured in. In a short time the preservative will begin to flow into the sapwood of the post, forcing the natural sap out at the small end. When all the preservative has flowed from the tire tube into the wood the tube is removed and the post is taken from the rack.

The length of time required for the preservative to flow into the wood will vary with the quantity used, the kind and condition of the wood, season of the year, thickness of sapwood, and other factors. With aspen posts 7 feet long, 8 to 24 hours were usually sufficient. Most rapid treatment outdoors can be expected during warm weather. The preservative will flow into wood more slowly during cool weather and outdoor treatment by this method in freezing weather will usually not be practical. If posts are brought indoors for treatment in freezing weather they should be allowed to thaw out thoroughly before the treatment is begun.

Green Posts Required

The tire-tube method is suitable only for wood that is thoroughly green. The sooner posts are treated after cutting the better. If possible, they should be treated within 24 hours, especially in hot-dry weather. If the ends have dried too much within a 24-hour period they should be cut off for an inch or so until wet surfaces are exposed. If the posts must be held longer before treatment, the ends may be coated with paint or similar material that will retard drying, then when ready to treat, an inch or more of wood can be sawed from each end. If it is convenient to keep the posts submerged in water (not floating) they will remain in good condition for treatment for many weeks. The important requirement is that there shall have been no drying of the end surface that the preservative must enter.

The Apparatus

Sections of inner tubes from used automobile or truck tires constitute the most important part of the treating apparatus. The sections should be about 24 to 30 inches long and free from leaks. Small leaks may be stopped with cold tire patches or with small clamps like those used in chemical laboratories. A small clamp that will serve for this purpose can be made with two small pieces of wood about 1/4 by 3/4 by 2-1/2 inches in size with a 1/8-inch stove bolt through their center to draw them together (fig. 2, A,B). Used tubes can usually be obtained very cheaply from garages or junk yards. It is always best to use tubes that are somewhat smaller than the posts on which they are to be placed, in order to get a tight connection. In attaching the tube it is merely doubled back over itself for about 4 to 6 inches and the folded edges stretched over the end of the post. The doubled-back portion is then easily unrolled into place. If the peeled surface is irregular it is well to spread axle grease or similar material over it before unrolling the doubled-back portion, to avoid leakage. After a few posts have been treated, experience will indicate the type of surfaces that will require coatings of grease.

A very simple, homemade stretcher that will simplify slipping the tube on the post is shown in figure 2, C. It can be made of 4 to 6 smooth hardwood sticks

Continued on next page

about 3/4 by 1-1/2 by 24 inches in size that are tapered at one end and held together by rubber strips cut from a tire tube. Two stretchers will be convenient if both large and small posts are to be treated; one for small posts with 4 sticks and another for large posts with 6 sticks. By using the stretcher in the manner illustrated in figure 3, small tubes can be made to stretch over fairly large posts with relative ease.

After the tube is on it should be tied in place by several wrappings of cord, wire, rubber band or other suitable material, to prevent leakage of preservative. A strip of inner tube about 1-1/2 inches wide and about 4 feet long will serve very well for the purpose.

Any convenient support or rack may be used that permits the small end of the post to be 18 inches or more lower than the large end, provides a means for holding the loose end of the tire tube, and allows the drip to escape freely from the post. Low racks will generally be found most convenient for lifting and moving the posts. The loose end of the tube may be tied to the supporting frame with rope or cord. Small "C" clamps are very convenient for this purpose. If preferred, the posts may be allowed to stand upright against any convenient support.

If the drip from the posts is to be saved for mixing new solution, provision must be made to catch it in a suitable tank or barrel. A good weighing scale should be available, also accurate measuring cans for measuring water and solution. Cans or pails marked off in gallons and quarts will generally be useful.

If a large number of posts are to be treated the apparatus should be selected with considerable care, so as to make all operations as convenient as possible. Much unnecessary labor can thus be avoided.

The Preservative

Only preservatives dissolved in water may be used, for oils will not penetrate when applied to green wood in this manner. Various proprietary and nonproprietary preservatives in water solution can undoubtedly be employed. At present, however, zinc chloride seems most promising because of its cheapness, availability, safety, and convenience, combined with moderate effectiveness.

Zinc chloride is available in three forms, granulated, fused, and concentrated solution. In the granulated form it is in dry, white grains or small pieces which dissolve readily in water. It must be shipped in airtight containers for, when exposed to the air, it quickly takes up moisture and the grains stick together or even melt in the absorbed water. When using this form, therefore, it is desirable to mix the entire contents of the container with water at one time whenever practicable. If any unused granules must be left in the container it should be tightly closed as quickly as possible.

The fused form is very inconvenient to handle in small quantities. It is shipped as a solid mass inside of an airtight container. It can be dissolved

Continued on next page

slowly by chopping holes in the container and placing both container and contents in the water or the container may be chopped to pieces and thus removed from around the zinc chloride mass. Since fused zinc chloride, when purchased in small quantities, is no cheaper than the granulated form, and may even be more expensive, there is seldom any advantage to the small consumer in using it.

The most convenient form of zinc chloride for small users is the concentrated solution. Various manufacturers ship the solution in different strengths, usually about 48 to 72 percent. The purchaser should know what strength of solution is being furnished so that he may know how much water to add to make the proper treating solution, as well as what the zinc chloride part of the solution is costing him. The solution form is usually the cheapest to buy, except where there is a long freight haul. Since the solution is generally about half water the freight cost will be higher than on an equal amount of zinc chloride shipped in the dry form.

The cost of zinc chloride will vary considerably with the quantity purchased, the sizes of the containers, the form (whether granulated, fused, or solution), and other factors. In solution form prices as low as 3 or 4 cents per pound (equivalent to about 6 to 8 cents per pound for the zinc chloride in the solution) are sometimes quoted when several hundred pounds are purchased. To this cost freight must be added. In smaller quantities the prices are likely to be higher. Since the prices vary so widely the prospective purchaser should ask for prices from several companies on both the dry form and the solution form, stating the quantity desired. If the prices quoted include freight they will simplify comparing the net delivered cost, but usually they will be quoted f.o.b. the dealer's warehouse and the purchaser will have to determine the freight cost in order to make comparisons.

In asking for prices it should be stated that the zinc chloride is to be used for wood preservation and the dealer should be asked to state the purity of his product or the concentration of zinc chloride, if in solution. The American Wood-Preservers' Association requires that in the solid form there shall be at least 94 per cent of zinc chloride and not more than 0.1 per cent iron. A moderate amount of impurities is not objectionable. A 100 per cent pure product would be very satisfactory, but usually too expensive.

Preparing the Treating Solution

From the work done thus far it is believed that a 10 percent solution of zinc chloride will be suitable for treating posts of most species by the tire-tube method. Further experience may show, however, that different solution strengths are desirable for some species. For example, posts that are practically all sapwood may treat best with 1-1/2 to 2 times the quantity of solution indicated in table 2, but with the solution proportionately reduced in strength.

If the zinc chloride has been purchased in granulated or fused form, and is reasonably pure, a solution of approximately 10 per cent strength can be made by mixing in the proportion of 10 pounds of the solid zinc chloride to 90 pounds

Continued on next page

of water. If the zinc chloride is 95 per cent pure about 10-1/2 pounds will be required for 90 pounds of water. It is not practical to measure quantities of solid zinc chloride and, even with water, weighing is generally more accurate than measuring. However, when it is too inconvenient to weigh the water it may be measured. A gallon of water at a temperature of about 60°F. weighs about 8-1/3 pounds. For 10-1/2 pounds of 95 per cent pure zinc chloride, therefore, about 10-3/4 gallons of water are required to make a 10 percent solution.

If the zinc chloride has been purchased in concentrated solution the amount of water required will depend upon the concentration. Table 1 shows the approximate proportions of concentrated solution and water required for the different strengths of zinc chloride solution commonly available, to produce a treating solution of 10 percent strength:

Table 1

Strength of concentrated solution	Approximate amount of water to be added to 10 pounds of concentrated solution to make a 10 percent treating solution	
Percent	Pounds	Gallons
48-1/2	38-1/2	4-1/2
50	40	4-3/4
70	60	7-1/4
72	62	7-1/2

Amount of Solution per Post

It is considered good practice to have the posts absorb about 1 pound of zinc chloride per cubic foot of wood. For this reason different amounts of preservative solution are required for posts of different size. Table 2 will be helpful in determining the amount of 10 percent solution to use for individual posts.

The average middle diameter of a post (for use with table 2) is found by averaging the diameters of the two ends, the measurements being taken inside the bark. When the ends of a post are not true circles, which is very often the case, it is desirable to measure the diameter at each end in more than one direction and thus obtain an approximate average figure. The average diameters obtained in this way for the two ends are then averaged together to give the average middle diameter. A high degree of accuracy is not necessary.

Continued on next page

Table 2.--Amounts of 10 percent zinc chloride solution required for posts of different sizes

Average middle diameter of post, inside bark	Approximate amounts of solution for posts that are:									
	6 feet long		7 feet long		8 feet long		10 feet long		12 feet long	
Inches	Pounds	Gallons	Pounds	Gallons	Pounds	Gallons	Pounds	Gallons	Pounds	Gallons
A	B	C	D	E	F	G	H	I	J	K
3	3	1/4	3-1/2	1/2	4	1/2	5	1/2	6	3/4
3-1/2	4	1/2	4-3/4	1/2	5-1/4	1/2	6-3/4	3/4	8	1
4	5-1/4	1/2	6	3/4	7	3/4	8-3/4	1	10-1/2	1-1/4
4-1/2	6-3/4	3/4	7-3/4	3/4	8-3/4	1	11	1-1/4	13-1/4	1-1/2
5	8-1/4	1	9-1/2	1	11	1-1/4	13-3/4	1-1/2	16-1/4	1-3/4
5-1/2	10	1	11-1/2	1-1/4	13-1/4	1-1/2	16-1/2	1-3/4	19-3/4	2-1/4
6	11-3/4	1-1/4	13-3/4	1-1/2	15-3/4	1-3/4	19-3/4	2-1/4	23-1/2	2-1/2
6-1/2	13-3/4	1-1/2	16-1/4	1-3/4	18-1/2	2	23	2-1/2	27-3/4	3
7	16	1-3/4	18-3/4	2	21-1/2	2-1/4	26-3/4	3	32	3-1/2
7-1/2	18-1/2	2	21-1/2	2-1/4	24-1/2	2-3/4	30-3/4	3-1/4	36-3/4	4
8	21	2-1/4	24-1/2	2-3/4	28	3	35	3-3/4	42	4-1/2
8-1/2	23-3/4	2-1/2	27-1/2	3	31-1/2	3-1/2	39-1/2	4-1/4	47-1/4	5-1/4
9	26-1/2	3	31	3-1/2	35-1/4	4	44-1/4	4-3/4	53	5-3/4
9-1/2	29-1/2	3-1/4	34-1/2	3-3/4	39-1/2	4-1/4	49-1/4	5-1/2	59	6-1/2

Continued on next page

The following example illustrates how table 2 can be used to determine the amount of 10 percent zinc chloride solution required to treat a post of a known size. Suppose a post is 7 feet long and has an average middle diameter of 4-1/2 inches. The amount of 10 percent solution required will be found in column D in pounds or column E in gallons, on the line with the 4-1/2 in column A. They show that about 7-3/4 pounds or about 3/4 gallon will be required to treat the post. Similarly it will be found that an 8-foot post with an average middle diameter of 7 inches will require 21-1/2 pounds or about 2-1/4 gallons.

Waste of Solution

Although most of the liquid that drips from the end of the post during treatment is the sap of the tree (mostly water), it will usually contain a small amount of zinc chloride, generally less than 1/10 of a pound. This need not be wasted, however, if the drip is saved and used in the preparation of additional solution. For practical purposes the drip may be regarded as water, that is, no consideration need be given to the small amount of preservative that it contains. The sugar and other materials contained in the sap are in such small quantity that they need cause no concern, even if the solution becomes discolored. Cans under the posts or a trough sloping downward to a large container are convenient for collecting the drip.

Summary of Treating Operation

The following brief summary of the foregoing discussion indicates the different treating operations and the order in which they should follow each other:

1. Peel bark from large end of post for about 4 to 6 inches, leaving a smooth, clean surface so that a tight joint can be made between wood and rubber. (If the end surfaces of the posts are dry, cut the ends back until wet wood is exposed.)

2. Double back the end of the tube and place it on the large end of the post. The stretcher simplifies the job of putting the tube on the post.

3. Grease the peeled surface (if your experience indicates that it is necessary to make a joi t that does not leak).

4. Unroll the doubled-back portion of the tube and bind it tightly.

5. Place post on rack.

6. Fasten up loose end of tube.

7. Pour in measured amount of preservative solution.

8. After preservative has all flowed into the wood remove tube and place post in storage pile.

Continued on next page

Species of Wood

Experiments with the tire-tube method thus far have covered only a few species of wood and it is not yet known that all species will take treatment satisfactorily. Good treatments have been obtained at the Forest Products Laboratory in aspen (popple), jack pine, and loblolly pine. Other investigators have reported that red maple, sugar maple, red pine, pitch pine, northern white pine, eastern hemlock, red oak, black oak, hickory, spruce, yellow poplar, American elm, beech, and black gum are capable of treatment by the method. The results thus far indicate that good treatment can probably be obtained in any species that has a substantial thickness of sapwood.

Thickness of Sapwood

Since, in most species, the penetration of the preservative is confined almost entirely to the sapwood, the thickness of the sapwood on the posts determines the thickness of the treated zone. It is not known how much influence the thickness of the sapwood will have upon the life of the treated post. It is considered desirable, however, to have sapwood at least 1 inch thick on 4- to 5-inch diameter posts. On larger posts it is best to have a wider sapwood band. If posts with thinner sapwood than that recommended must be used they will undoubtedly be benefited by the treatment, but possibly not so much as those with thick sapwood. It is doubtful that the treatment will be economical on posts with durable heartwood and narrow sapwood. Such posts give long life without treatment.

Penetration

Although the penetration of the preservative, in most species, will be limited almost entirely to the sapwood, there may be slight penetration in the exposed heartwood at the ends of the post, especially the end to which the tube is attached. Some preservative may also diffuse into the heartwood in the interior of the post. At the end of the treating period the penetration, even in the sapwood, is likely to be streaked and incomplete, particularly near the small end of the post. Diffusion f preservative continues after the tube is removed, however, as long as the post remains in the green condition, and the untreated streaks gradually become impregnated in this manner. It is a good plan, therefore, to allow the bark to remain on the posts for a week or two, or even longer, after the treatment is finished.

Removal of Bark

If desired, the posts may be set in the ground without removing the bark. The treatment will make the bark stick to the wood much longer than it does on untreated wood. A strip of bark should be chipped off after the posts are set, at the place where the fence wires are to be attached, to permit firmer fastening. If preferred, however, this bark may be left on and longer staples used, to make up for the thickness of the bark.

The end of the post to which the tube was attached will be the most thoroughly treated and, therefore, should always be set in the ground.

Continued on next page

Coating Ends of Posts

While it is not necessary to coat the exposed wood it is believed that suitable coatings will be helpful in prolonging the life of the posts. A thick coating of tar, asphalt paint, pitch, or other similar material that will have a moisture retarding effect should reduce the rate at which the preservative is dissolved out of the wood by the water in the soil. If the posts are peeled before setting in the ground, the coating may be applied to all the underground parts and to the top end surface, leaving the remainder uncoated. If the bark is left on, the coating may be applied to the end surfaces and any other spots where bare wood is exposed. Coating the top end of the post should retard the checking of the wood at that point. Such coatings, when used alone, do not preserve the wood from decay, but when used over zinc chloride treated wood it is believed that they will have a useful effect. It is best to allow the posts to season for a few weeks so that the surfaces become dry before applying the coatings. Since no records are available on the life of posts without such coatings, in comparison with similar posts coated, it is not possible to say how much increase in life will be obtained by the use of the coatings.

How Long Will the Posts Last?

The tire-tube method of treating posts with zinc chloride is new and there has not been time to determine how many years the treated posts will last in a fence. Undoubtedly the life will be different with posts of different species, different size, different soils, and in different parts of the country. The life will be longer in comparatively dry soils than in wet soils, and longer in cold climates than in warm climates. Longer life will probably be obtained from posts with thick sapwood than from those with thin sapwood. Similarly, posts with the ends coated should last longer than those that are not coated.

While no average life figures have been obtained on posts treated by the tire-tube method some information is available on the life of posts treated with zinc chloride by other methods. This information indicates that posts containing about 1 pound of zinc chloride per cubic foot can reasonably be expected to last 10 to 15 years under ordinary conditions and, in some cases, they may last longer. This means that round posts of nondurable woods, such as aspen (popple), sap pine, and the like, can at small cost be made to be about as durable as good cedar posts used without treatment.

Service Records

It will be helpful if those who use the tire-tube method of treating posts will keep records showing the kind and sizes of the posts, and the date and number installed in different fences. Records should then be made year by year showing the number of treated posts removed and the reason for their removal. Since line fences are seldom disturbed they offer the best opportunity for studying the length of life obtained from posts.

Continued on next page

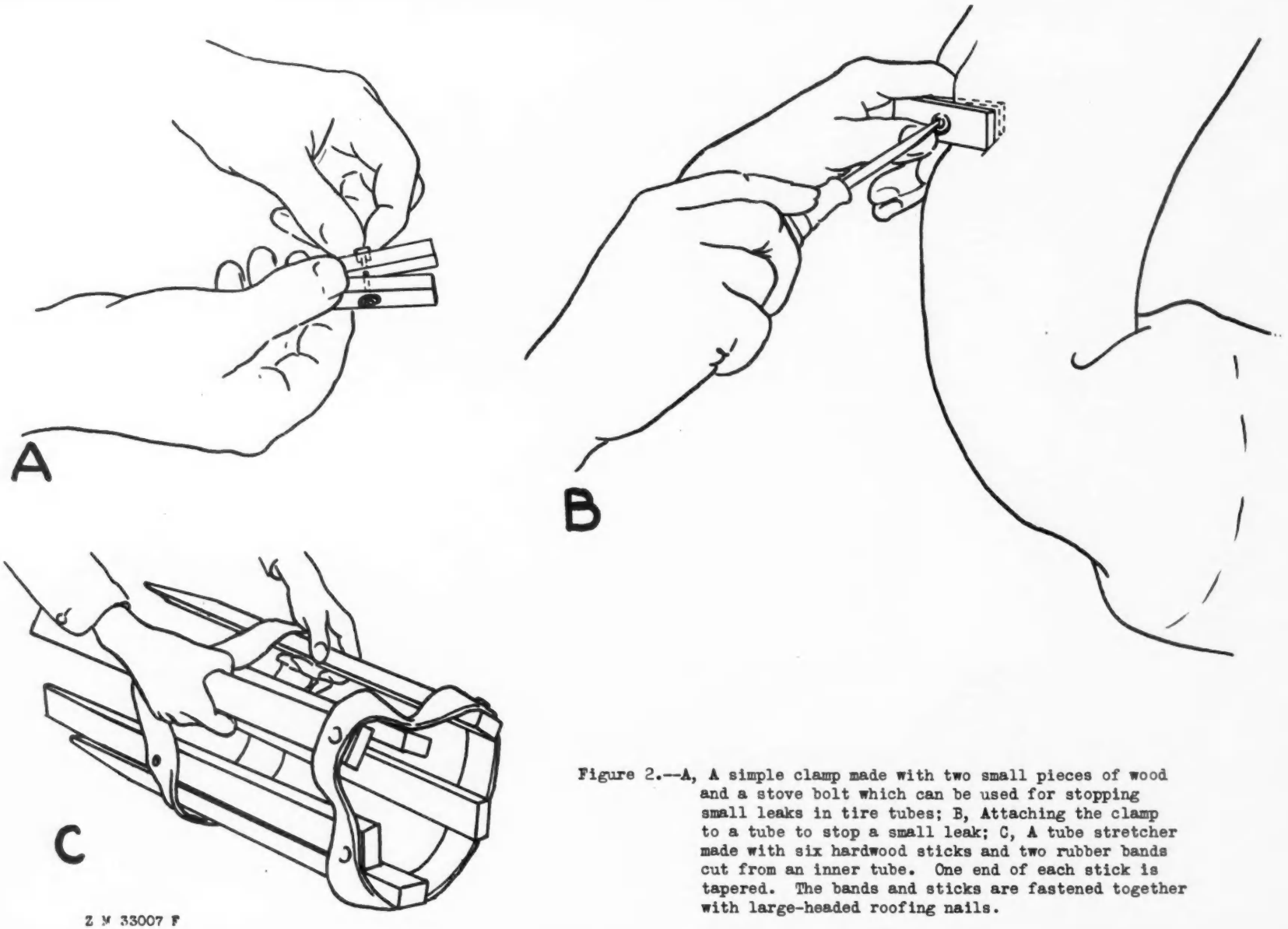
Other Uses

While the previous discussion has applied specifically to fence posts this method of treating can also be used for other classes of material used in the round form, such as poles, tobacco shade posts, rustic furniture exposed to outdoor conditions, log buildings, and log bridges.

Treating Trees With Branches On

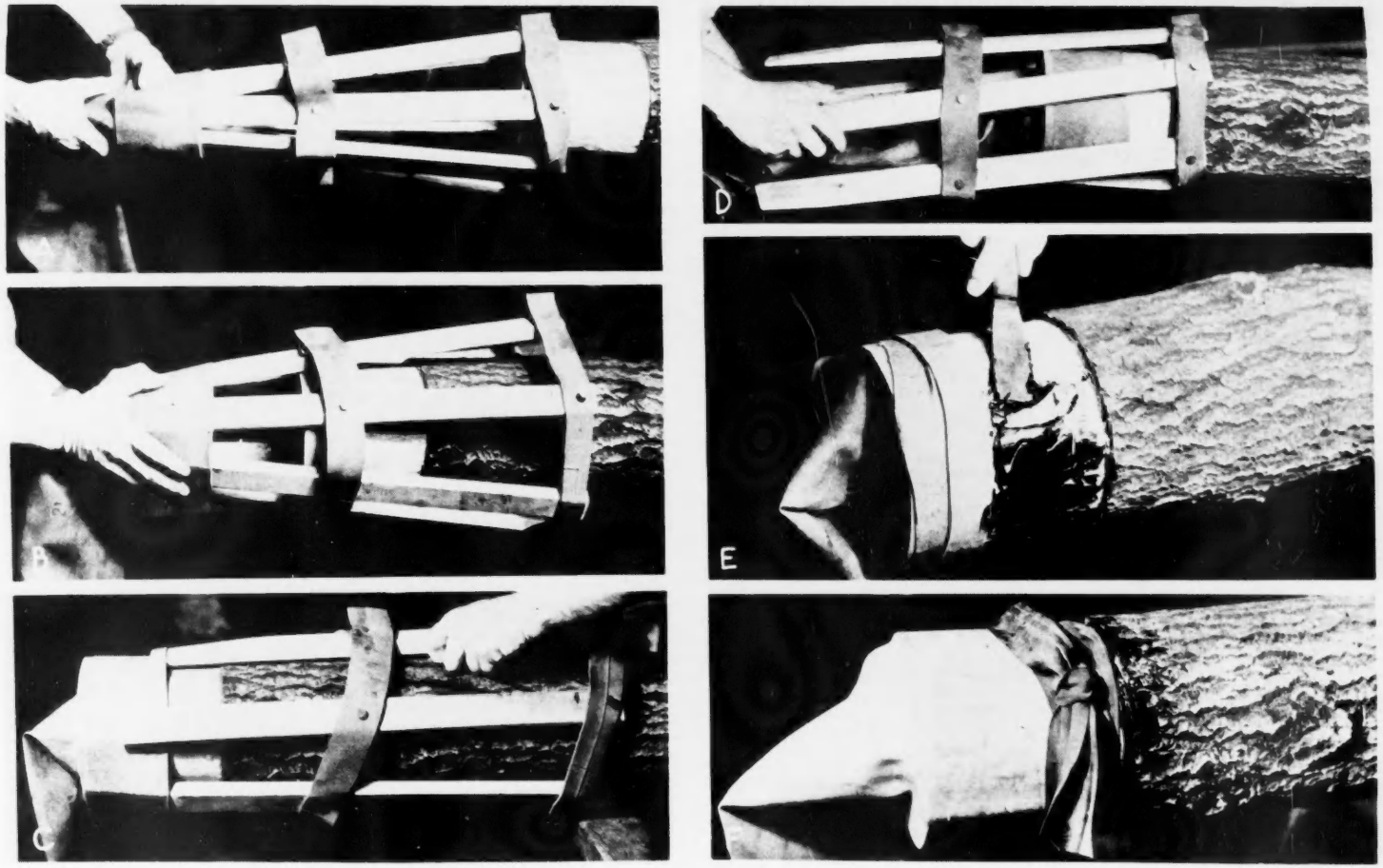
Standing trees or freshly felled trees with their branches on can be treated in the sapwood by adaptations of the Boucherie process worked out by the U. S. Bureau of Entomology & Plant Quarantine, Department of Agriculture, Washington, D. C. Instructions for making these treatments can be obtained by writing to that Bureau. A description of the method will also be found in the Journal of Forestry, Vol. 39, No. 1, January 1938.

Figure 1 -- Tire-Tube method of treating fence posts.



Z M 33007 F

Figure 2.--A, A simple clamp made with two small pieces of wood and a stove bolt which can be used for stopping small leaks in tire tubes; B, Attaching the clamp to a tube to stop a small leak; C, A tube stretcher made with six hardwood sticks and two rubber bands cut from an inner tube. One end of each stick is tapered. The bands and sticks are fastened together with large-headed roofing nails.



M 33006 F

Figure 3. - Attaching the tube to a post with the help of a stretcher.

(a) First the doubled-back portion of the tube is put over the ends of the stretcher sticks that are tapered. The other end of the stretcher hangs on the peeled end of the post.

(b) The stretcher sticks are then pushed over the end of the post causing the tire tube to stretch as it moves toward the post

(c) After the double-back portion is slipped over the end of the post the stretcher sticks are slipped out from under the tube one at a time.

(d) After all the sticks are out from under the tube, the stretcher is taken away by slipping it back over the tube

(e) Spreading grease or similar material on wood to avoid leakage

(f) After the grease is spread the tube is unrolled and tied with a rubber band cut from a tire tube

Agricultural News Letter (du Pont)
Vol. 6 - Nos. 8 and 9, August-September, 1938.

SULFAMIC ACID

EDITOR'S NOTE:- The article under this heading is given here in order to tell what this interesting chemical is, and to indicate some lines of its application. The fact that it is a crystalline solid offers new possibilities in handling and adaptability. Those in research work may have many other ideas concerning its utilization.

By-Dr. W. E. Gorden,
Grasselli Chemicals Department,
E. I. du Pont de Nemours & Co.,
Wilmington, Delaware.

Of interest to many agricultural research laboratories is a new inorganic acid recently developed by the Grasselli Chemicals Department of the du Pont Company. This material, Sulfamic Acid, has a formula $HO-SO_2-NH_2$ and is now being prepared on a semi-commercial scale from urea and Oleum. Because of its many unique properties it has created interest in widely different fields of research activities.

The unusual properties of Sulfamic Acid include the characteristics of being a non-volatile, non-hygroscopic crystalline solid, which when dissolved in water yields solutions which are highly ionized and strongly acidic - approaching hydrochloric and sulfuric acids in pH value. Although Sulfamic Acid is somewhat similar in structure to sulfuric acid, it is free from the strong dehydrating action of the latter and dissolves in water with practically no heat of solution. Of interest also is the fact that all ordinary salts of Sulfamic Acid (Ca, Ba, Pb, etc.) are highly soluble in water. For example, a saturated solution at 25°C., contains approximately 68% lead sulfamate, 66% ammonium sulfamate, 54% magnesium sulfamate or 53% sodium sulfamate.

Sulfamic Acid may be conveniently handled and packaged in the solid form and consequently offers important advantages over other inorganic acids which require considerable care in handling and shipping.

In its chemical properties, Sulfamic Acid behaves like other monobasic acids in its reactions with metals, oxides, hydroxides, amines and carbonates. Hot water slowly hydrolyzes Sulfamic Acid to Ammonium Acid Sulfate, but sulfamate salts are stable in neutral or alkaline solutions even upon boiling. Chlorine, bromine, chlorates and nitrites oxidize Sulfamic Acid to sulfuric acid with liberation of nitrogen. On the organic side, Sulfamic Acid reacts with primary alcohols to form alkyl ammonium sulfates. Aldehydes, amides, and phenols also react with sulfamic acid.

Continued on next page

Industrial applications for sulfamic acid which have shown promise, include the following:

(1) - Sulfamate salts, e.g., ammonium and calcium sulfamates as flameproofing agents for textiles, paper, insulation products, etc.

(2) - Use for the removal of excess nitrites or nitrous acid following diazotization reaction;

(3) - As a primary standard in acidimetry.

(4) - In leather tanning;

(5) - In soda - acid type fire extinguishers.

(6) - In the preparation of various pharmaceuticals.

(7) - In the preparation of dyestuffs and pigments.

In the field of agriculture, Sulfamic Acid and its salts have been proposed for the following purposes:

(1) - pH control in the preservation of fodder.

(2) - Use of ammonium sulfamate as an ingredient of fertilizer mixtures, taking advantage of its relatively high nitrogen content.

(3) - For controlling the acidity of soils, particularly those of an alkaline character.

Other applications to agricultural research problems are being investigated looking toward the large-scale utilization of this unusual product.

Agricultural News Letter (du Pont)
Vol. 6 - Nos. 8 and 9, August-September, 1938.

NEW REASONS AND MODERN METHODS FOR TREATING SEED GRAINS

EDITOR'S NOTE:- It is evident that growers can eliminate considerable crop damage by using the information given in this review of the status of seed treatment. Extension workers and others may use this material in a manner which is best suited to their need.

By Gilbert F. Miles,
Research Department,
Bayer-Semesan Company,
Wilmington, Delaware.

Now is the time for grain growers to be thinking about the control of smut and other seed-borne diseases in the grain crop to be sown this fall. Our knowledge on the subject of seed disinfection has been increased greatly in recent years by the work of the experiment stations and other research agencies. It should be profitable, therefore, for growers to review the present status of seed treatment with the purpose of revising, if necessary, whatever methods they are using for the control of smut and certain other seed-borne diseases of cereals.

Until recently our only reason for treating seed grains was to control stinking smut of wheat, loose and covered smuts of oats, and covered smut and stripe disease of barley. It is known now, however, that there are other diseases partially controlled by seed treatment which are often of greater economic importance than those mentioned. These diseases, which manifest themselves in the form of seed decay, root rots, and seedling blights, are caused also by fungi or molds carried over to a large extent on the surfaces of the seed. Because most of the damage by this group of diseases occurs underground, losses caused by them are seldom appreciated by farmers. Thin stands and weak plants caused by these diseases are too often incorrectly attributed to winter killing or other reasons.

The prevalence and importance of these root rot and seedling blight diseases and their partial control by seed disinfection make it necessary for us to broaden our conception of seed disinfection and its purpose. A hit-or-miss program in which the seed is treated every two or three years is utterly inadequate to cope with the grain disease situation as we now understand it. Disinfection of seed grains every year is necessary if growers are to obtain maximum profits.

The expansion of our knowledge of seed-borne diseases of grain has been accompanied fortunately by improvements in methods of controlling these diseases.

Continued on next page

Three different chemicals or groups of chemicals are available to the farmer for the treatment of his seed grains; formalin, copper carbonate, and ethyl mercury phosphate.

Formalin Still Used as a Liquid Method

Formalin, a solution of formaldehyde gas in water, gives good control of stinking smut of wheat and of loose and covered smuts of oats. For the treatment of wheat the customary recommendations call for a solution of one pint of formalin in 40 gallons of water. The seed is soaked in this solution for a period of five minutes, during which time the smut balls, which float to the surface, should be skimmed off. After soaking, the seed should be kept covered for four hours and then planted at once. The chief objection to this method of treating wheat is the danger of injury to the seed even when directions are closely followed.

Formalin is more suitable for the disinfection of oats than of wheat. Used in any one of several ways, it does a good job of controlling both loose and covered smuts. The procedure now in most general use is known as the dry or, more correctly, the mist method. One pint of formalin and one pint of water are mixed and the quart of solution is applied to fifty bushels of oats by means of a hand sprayer such as is commonly used for fly sprays. As the operator shovels the oats from one pile to another, an assistant sprays each shovelful by three or four strokes of the sprayer.

After treating a few bushels, the amount of solution used should be noted, and the number of pump strokes per shovelful of grain increased or decreased so as to apply the solution at the rate of one quart to 50 bushels of oats.

The treated oats should be left in a pile covered with canvas or other convenient covering for five hours. They should then be uncovered and spread out to liberate the formaldehyde vapors. To avoid injury, oats treated with formalin should be sown as soon as possible. It is advisable to treat on one day only that amount of seed which can be planted the next day.

Copper Carbonate for Wheat Only

Copper dusts, of which copper carbonate is the usual toxic principle, are suitable for use on wheat, but not on oats or barley. Some of these dusts are essentially pure copper carbonate, containing the equivalent of about 50% metallic copper, while others are sold in a diluted form and contain about 20% metallic copper equivalent.

The recommendations for the use of copper carbonate in the control of stinking smut of wheat vary in different sections of the country. Ordinarily two ounces of the pure or three ounces of the diluted copper carbonate dust is used to each bushel of seed wheat.

Copper carbonate is not soluble in water and does not form a vapor, and hence in using it care must be taken to distribute the dust with great thoroughness over the entire surface of all the seed. Seed treaters which accomplish their

Continued on next page

purpose by means of a rotating drum or revolving paddles are suitable for applying copper carbonate dusts provided the treating operation lasts for a period of a minute or preferably two minutes. The shovel method, as described for treating oats with formalin, is not satisfactory for treating wheat with copper carbonate; neither are the gravity type treaters.

Copper carbonate dust on seed wheat reduces the drilling rate by about 10%, and allowance should be made for this in setting the planting rate for the drill.

Copper carbonate has the unfortunate property of hardening like cement if allowed to become wet and then dried. During periods of rains or dampness, the caking of the dust around the working parts of the drill may result in damage when the drill is first moved after a period of idleness. Drill breakage can be avoided by first moving the drill by hand to make certain all parts are working freely before starting it by team or tractor.

The dust may be applied to the seed at any time prior to planting without fear of injury to the seed.

Ethyl Mercury Phosphate for Wheat, Oats, Barley

The most recent addition to the list of seed disinfectants is a product containing as the fungicide 5% ethyl mercury phosphate. (It is sold under the trade name of New Improved Ceresan, which should not be confused with a product sold for the treatment of cotton seed and known as 2% Ceresan.)* It is recommended by the manufacturers and by the experiment stations in most of the important grain growing states as a disinfectant for wheat, oats and barley at the rate of one-half ounce per bushel of seed, the same dust and the same methods of applications being used for all three grains.

Ethyl mercury phosphate is soluble in water and when applied to seeds and exposed to atmospheric or soil moisture, it changes slowly to a vapor form, which accounts for its effectiveness on oats and barley as well as on wheat. Because of its volatile properties, it lends itself well to almost any type of seed treating method. Farmers with small acreages of grain will find it convenient to use the simple shovel method described by the manufacturer. Those with larger amounts of seed to treat have their choice of any of the rotary or gravity type treaters, either home-made or commercial, commonly used for the purpose.

In using this dust, excessive dosages should be avoided. Any quantity of dust above one-half ounce per bushel of seed is simply a waste, and dosages in excess of four times that amount may cause injury to the seed. Although it is recommended that seed should not be treated with ethyl mercury phosphate more than three months before planting, it is probably true that seed which is well cured and dry at the time of treatment will not be injured even if stored from one planting season to the next.

Because of the low rate of application and the physical properties of the dust itself, seed treated with ethyl mercury phosphate dust flows through the drill at the same rate as untreated seed, and hence no correction in the drill setting need be made.

Continued on next page

Modern Seed Treaters Speed-up the Job

Improvements in seed treating chemicals available for controlling seed-borne diseases have been accompanied by advances in the field of seed treating equipment. The capacity of seed treaters has been increased so much that on the average farm the seed treating job takes only an hour or so. Commercial and even home-made treaters with capacities of fifty to one hundred bushels of seed per hour are in common use. Plans or patterns for the construction of rotary and gravity type treaters costing only a few dollars can be obtained free.

Handle Seed Treating Chemicals with Care

Now for a word of precaution in handling seed disinfectants. Remember that all of them are poisonous and handle them, as you do gasoline, with proper respect for their dangerous properties.

No seed treating chemicals should be inhaled in large quantities. Never use them in a closed room. Whenever possible, do the seed treating job out-of-doors. If it must be done indoors, then provide good cross ventilation. When using dust disinfectants, wear a dust mask or a dry cloth over nose and mouth. Read and observe strictly the precautions prescribed for handling each chemical.

Seedsmen, custom treaters and others treating seed on a large scale should provide dust masks for every worker. The filter pads in the masks should be changed once a day or oftener, if necessary, to provide clean filtering surfaces. Under some conditions it may be advisable to install an inexpensive ventilating system with an exhaust fan to keep the atmosphere free from dust. Plans for this sort of ventilating equipment can be obtained without charge from some manufacturers of seed disinfectants.

---

*"Ceresan" is a trade mark registered in the U.S. Patent Office by Bayer-Semesan Company, Wilmington, Delaware.

Agricultural News Letter (du Pont)
Vol. 6 - Nos. 8 and 9, August-September, 1938.

THE WILDLIFE CROP

EDITOR'S NOTE:- It is with considerable satisfaction that the following is offered because it has been the editor's privilege to hunt on a few farms in Michigan where the program as laid out here was followed. The farmer received a sum for each bird killed on his acreage but limited the number killed per season, so that his re-stocking cost was very little. This crop deserves more cultivation.

By- Henry P. Davis, Secretary,
The American Wildlife Institute,
Washington, D. C.

Whether wildlife restoration efforts fail or succeed depends to a large degree upon the farmer. Wildlife can, and should be, considered a crop, just as oats, wheat or corn. Until the farmer, who manages more than 50% of the country's acreage, regards wildlife as a crop the future of many of the smaller species shall remain in doubt - and the farmer himself will be overlooking what might prove a lucrative source of income.

The soy bean, lespedeza, and wild blueberry, to mention only a few, are examples of new farm crops developed within recent years. They have all proved profitable to the farmer and opened up new sources of income.

Wildlife can prove just as profitable to the farmer as these other new crops. Let us stop to analyze and justify this statement before considering how the farmer can raise a crop of wildlife.

While it will take many years for the wildlife crop to pay real dividends to the farmer, the immediate returns are not negligible. Let us suppose, for instance, that Farmer Jones follows a few simple rules that bring about a good crop of wildlife on his property. Right off the bat he will have not only good hunting for himself, but for his friends and sportsmen from the city.

Looking at it from a purely mercenary standpoint, Farmer Jones, in offering the sportsmen from the city an inducement to come to his country, is doing exactly what is being done every day by the Chambers of Commerce and similar organizations in the cities.

The city sportsmen willingly spend much for their sport, and they will pour new money into Farmer Jones' locality. Even if Farmer Jones, himself, never receives a cent of this money directly, he is bound to benefit by the prosperity of his community as a whole.

Continued on next page

Not only will the city sportsman leave many a dollar in the community, but the chances are that he or his friends will become interested in the land which maintains a good game crop. They will like the country, just as did Farmer Jones' father and grandfather. They may want to buy property there and develop it further. Real estate values then will soar and Farmer Jones will again profit.

More concrete returns will come in the future. Suppose Farmer Jones' place becomes known as a great hunting grounds. He grants hunting privileges freely to responsible and decent sportsmen - and then he really begins to profit.

Perhaps the sportsmen are only too glad to pay little Jimmy Jones, Farmer Jones' son, a nice substantial bit of vacation money for leading them to the best spots for pursuing their sport. Maybe Farmer Jones can add to his income by boarding and otherwise caring for the hunting dogs of his sportsmen friends. Comes lunch or dinner time and the nimrods return to Farmer Jones' home to enjoy a grand country dinner - served at a price to make Mrs. Jones a very handsome profit, yet well within the means of the hunters.

The day or days of hunting end and the sportsmen return home - probably taking country eggs, chickens, butter and one of Mrs. Jones' cakes home with them - well satisfied with having enjoyed everything that makes for a good hunting trip. Farmer Jones, Mrs. Jones and little Jimmy Jones also are happy. They have enjoyed the association of good sportsmen and have made a neat little profit in the bargain. A mutually satisfactory undertaking has been completed.

"Any plan of conservation that does not pay serious attention to the land-owner is grievously handicapped," said Carl D. Shoemaker, Secretary of The National Wildlife Federation recently.

"For the bulk of our people, the key to outdoor recreation is held by the farmer. It costs a lot more to establish and maintain a golf course than it does to make a farm yield good shooting, and yet it is a lot easier for the average man, the working man, the man who counts his dimes, to find a place to play golf than it is for him to find a place where he can hunt."

So much for the importance of the wildlife crop to both the farmer and the sportsman. Now how can the farmer raise such a crop. The rules are few and simple.

First of all, the farmer must provide food and cover for wildlife. "Clean" farming discourages wildlife. Brushy hedgerows and patches of food and cover scattered about and protected from grazing cattle or horses will pay dividends on the farm. Needless burning not only drives away wildlife, but hurts the land and the farmer's other crops as well. Birds are the greatest check on destructive insects. Drive the birds from your farm, and the insects will have practically a free hand. When you burn needlessly, you are driving the birds away, by depriving them of their homes. The insects will come back but not the birds.

Continued on next page

There are other simple methods of helping to increase the wildlife on your farm. The American Wildlife Institute will gladly send pamphlets describing these methods simply to anyone who asks for them. Just write the American Wildlife Institute, Washington, D. C., that you are interested in raising a wildlife crop, and all the necessary information will be sent to you. Also write your state game commission or the U. S. Bureau of Biological Survey at Washington, D. C.

Remember, that as the farm goes, so goes wildlife. Statistics emphasize this very forcibly. The total acreage under public control in this country is 413,456,500 acres, including federal and state wildlife refuges, federal and state parks, federal and state forests and public domain. Some 270,000,000 acres are in private forests. More than half the total land area of the United States - 1,054,515,000 acres or 55.4 percent to be exact - is in farm lands.

These figures just serve to emphasize the fact that without the whole-hearted support of the men who not only live closest to the life-giving soil but control so much of it no wildlife restoration program can hope to succeed.

Agricultural News Letter (du Pont)
Vol. 6 - Nos. 8 and 9, August-September, 1938.

PHYSIOLOGICAL ACIDITY OF COMMERCIAL MIXED FERTILIZERS

EDITOR'S NOTE:- Most crops will produce better in a neutral soil. Practically every Agricultural College and Experimental Station has definite recommendations for liming acid soil. The addition of lime to mixed fertilizers, particularly in the dolomite form is one of the outstanding developments in the manufacture of fertilizers. It is believed that our readers will profit by a study of this material.

By- A. L. Mehring, Associate Chemist
Fertilizer Research Division,
Bureau of Chemistry and Soils
U. S. Department of Agriculture,
Washington, D. C.

Liming materials have long been used in the manufacture of commercial fertilizers. One of the earliest of these uses was as a conditioner to improve drillability and another was to neutralize free acids in order to prevent them from destroying the bags. These uses have declined in importance in recent years because the use of Cyanamid and free ammonia in mixed fertilizers eliminates any need for liming and also because better methods of manufacture have lessened the need for conditioners.

Dolomitic limestone has been used as an economical source of magnesium in mixed fertilizers for at least 20 years and ordinary limestone is sometimes used to reduce run-of-pile superphosphate, containing as a rule 18 or 19 per cent available P_2O_5, to 16 per cent grade. Lime and limestone are also used to make certain fertilizer materials such as calcium cyanamide and basic lime phosphate. These uses are increasing in importance but the largest use of liming materials by fertilizer manufacturers in the United States at present is in the preparation of non-acid forming fertilizer mixtures.

The custom of adding limestone to commercial fertilizers to make them non-acid forming, or in other words, to control the acidity developed in the soil by certain nitrogenous fertilizer materials is a recent development. It began about 1929 largely as a result of the work of Pierre (1). It grew slowly but steadily until 1933 and then spread with great rapidity in 1934 and 1935.

The need of adding limestone to mixed fertilizers to control physiological acidity did not exist until changing economic conditions made ammoniacal nitrogen much cheaper than other forms of nitrogen. Since this form of nitrogen is largely responsible for physiological acidity its greatly increased consumption due to low prices created a problem in some sections.

Continued on next page

A general recognition of this condition and the development of satisfactory means for correcting it are due chiefly to the following investigations: (1) Parker (2) showed conclusively both from the agronomic and economic standpoints that it is desirable to add dolomite to fertilizers the nitrogen of which is derived largely from ammoniacal sources, and which are low in calcium and magnesium; (2) Pierre (3) developed a method for determining physiological acidity or basicity in mixed fertilizers. He also worked out in terms of calcium carbonate ($CaCO_3$) equivalents the quantities of acidity or basicity developed in the soil by unit quantities of various fertilizer materials; (3) Mehring and Peterson (4) reported that the average equivalent physiological effect on the soil of the materials used to make mixed fertilizers had changed from a basicity of 40 pounds of $CaCO_3$ in 1900 to an acidity equivalent to 150 pounds of $CaCO_3$ per ton of mixed fertilizer in 1932. It was also pointed out that this could be corrected by substituting limestone for sand in making these mixtures at very little difference in cost to the consumer; and (4) Cooper and Paden (5) showed that the acidity of a considerable proportion of the soils of South Carolina had already reached or exceeded the limit of tolerance for good crop production. Presumably similar conditions prevailed throughout the Atlantic Coast Plain where a large part of the fertilizer is consumed. Obviously, if large areas of soil are already as acid as the crops grown upon them are able to tolerate, fertilizers that would make them still more acid should not be used unless these soils were limed.

Neither the quantities of liming materials used in making mixed fertilizers nor the amount of acid likely to be produced by the average commercial fertilizer were known for any recent year. It is very desirable to know the probable effects upon our soils of the fertilizers being applied to them and it was the purpose of this study to obtain further information on this subject. Accordingly, the quantities of liming materials consumed in making fertilizers in recent years were determined and the physiological acidity of the average mixed fertilizers for certain years were calculated. This paper gives the results.

---

(1) Pierre, W. H. Nitrogenous Fertilizers and Soil Acidity: II. The Use of Fertilizer Combinations, Lime and Basic Slag in Correcting the Acidity Formed by Various Nitrogenous Fertilizers. J.A.S.A. 20, 270-9 (1928).

(2) Parker, F. W. The Importance of Calcium and Magnesium to the Nitrogen and Fertilizer Industries. Am. Fert. 76, No. 2, 13 (1932).

(3) Pierre, W. H. Determination of Equivalent Acidity and Basicity of Fertilizers. Ind. Eng. Chem., Anal. Ed. 5, 229-34 (1933).

(4) Mehring, A. L. and Peterson, A. J. The Equivalent Physiological Acidity or Basicity of American Fertilizers. J.A.O.A.C. 17, 95-100 (1934).

(5) Cooper, H. P. and Paden, W. R. The Acidity or Basicity of Fertilizers and Their Action on Soils and Soil Acidity. Am. Fert. 79, No. 13, 9 (1933).

Continued on next page

Liming Materials in Fertilizers

It was considered impractical to ascertain from the large number of fertilizer manufacturers the quantities of liming materials used in making mixed fertilizers and therefore a questionnaire was sent in the summer of 1937 to the much smaller number of limestone producers asking them to report the quantities sold for use in the manufacture of mixed fertilizers in 1929, 1933, 1935 and 1936. Limestone containing less than 10 per cent MgO was to be reported separately from that containing over 10 per cent, the latter being called dolomite or dolomitic limestone.

Returns were obtained from all companies that are likely to have supplied limestone for fertilizer production. The totals are presented as limestone, dolomite and all other materials in Table 1. The "all other" category includes partly-calcined dolomite, hydrated dolomitic lime, marl and oyster shell.

Table 1. Sales (1) of Certain Liming Materials to Fertilizer Manufacturers and Estimated Disposal

(short tons)

Material	1929	1933	1935	1936
Limestone (2)	3,105	12,145	12,662	21,143
Dolomite (3)	67,849	99,609	273,599	293,853
All others (4)	none	4,200	7,275	9,775
Total	70,954	115,954	293,536	324,771
Used in making superphosphate sold to consumers	17,000	5,000	4,000	4,500
Used in making basic lime phosphate	2,000	1,300	1,650	1,700
Retailed unmixed to consumers	18,000	11,000	14,000	16,000
Difference used in mixed goods	33,954	98,654	273,886	302,571

The totals as reported did not include caustic lime, hydrated lime or sales of limestone for making some fertilizer materials, but did include limestone retailed by fertilizer manufacturers to their customers in an unmixed state, that used as a conditioner or filler in superphosphate sold directly to consumers and that used to make basic lime phosphate, because the amounts thus used could not be separated by the parties that filled out the questionnaires. Deductions are therefore made in Table 1 for these quantities.

(1) Includes liming materials produced and consumed by fertilizer companies.
(2) Less than 10 per cent MgO.
(3) More than 10 per cent MgO.
(4) Calcareous marl, partly calcined dolomite, etc.

Continued on next page

When the quantities of liming materials used for other purposes are deducted from the total sales of these materials to fertilizer manufacturers it is found that 34,000 tons were used in 1929 and about 300,000 tons in 1936 for making commercial mixed fertilizers.

Equivalent Acidities of Mixed Fertilizers

The quantities of various materials used in making commercial mixed fertilizers, the average composition of these materials and other information relating to the mixed fertilizers manufactured in 1935 are given in Table 2. The net physiological acidity of these fertilizers was calculated from the tonnages of the various materials used in making them and Pierre's factors mentioned above. Data are not available from which one can calculate corresponding figures for other recent years with the degree of accuracy attained for 1935, but sufficient data are available to permit fairly accurate estimates to be made for several years. These results are given in Table 3. The figures for 1929 and 1935 are based almost entirely on adequate statistics and are believed, therefore, to be quite accurate. The figures for the other four years shown are based largely on statistics also but in each case one calculation involved an estimate. The estimated figures are indicated in Table 3 by footnotes. These figures, however, were arrived at only after careful consideration of all available facts bearing on the situation and in each case these included a census figure or compilation of the same kind for one or more nearby years.

The data obtained in the present study together with those previously available on the average equivalent acidity of commercial fertilizers are plotted in graph form. (See next page - Figure 1)

It appears that the physiological acidity of mixed fertilizers has decreased greatly since 1934, although it had been increasing rapidly up to 1933. The use of dolomitic limestone in commercial mixtures also increased rapidly from 1929 to 1933 but, owing to a decided shift from nitrate to ammoniacal nitrogen, the acidity was increasing at a still greater rate. In 1934, however, manufacturers began to use relatively less acid forming materials in greater proportion in making mixed goods and the use of dolomite in such fertilizers also became much more widespread. This is still the case and thus the problem of physiological acidity due to the use of commercial fertilizers seems to be well in hand.

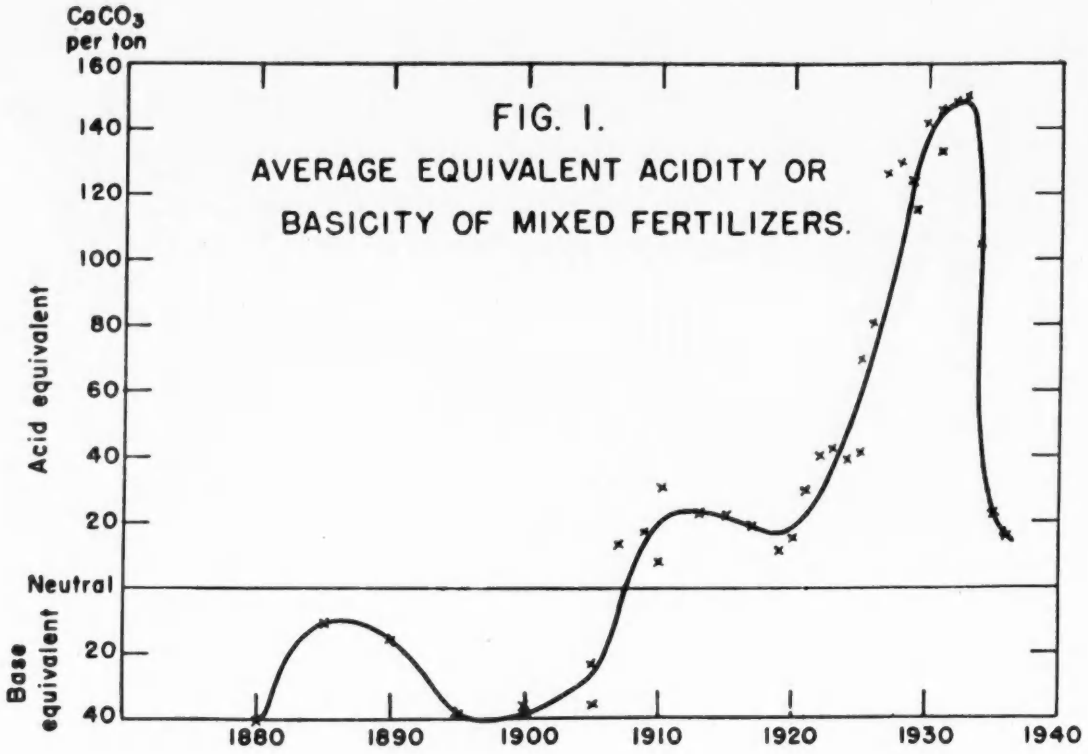


FIG. 1.

AVERAGE EQUIVALENT ACIDITY OR BASICITY OF MIXED FERTILIZERS.